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1FW AF/2871

PATENT APPLICATION

ATTORNEY DOCKET NO. 30001064-2

OIPE JC67 MAY 0 5 2004 PATENT & TRADEMARK OFFICE

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IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Kitson et al.

Confirmation No.: 2104

Application No.: 09/815,999

Examiner: Hoan C. Nguyen

Filing Date: March 23, 2001

Group Art Unit: 2871

Title: LIQUID CRYSTAL ALIGNMENT

Mail Stop Appeal Brief-Patents
Commissioner For Patents
PO Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith in **triplicate** is the Appeal Brief in this application with respect to the Notice of Appeal filed on **March 3, 2004**.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) $330.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

( ) (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

( )	one month	$110.00
( )	two months	$420.00
( )	three months	$950.00
( )	four months	$1480.00

( ) The extension fee has already been filled in this application.

( ) (b) Applicant believes that no extension of time is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **08-2025** the sum of **$330.00**. At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account 08-2025 pursuant to 37 CFR 1.25. Additionally please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16 through 1.21 inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees. A duplicate copy of this sheet is enclosed.

(**X**) I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, Alexandria, VA 22313-1450. Date of Deposit: **May 3, 2004**

OR

( ) I hereby certify that this paper is being transmitted to the Patent and Trademark Office facsimile number________ on ________

Number of pages:

Typed Name: **Michelle Pagliarulo**

Signature: Michelle Pagliarulo

Respectfully submitted,

Kitson et al.

By Paul D. Greeley

Paul D. Greeley

Attorney/Agent for Applicant(s)
Reg. No. **31,019**

Date: **May 3, 2004**

OIPE JC67 MAY 0 5 2004 PATENT & TRADEMARK OFFICE

Docket: 30001064US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

Applicants:	Kitson et al.
Serial No:	09/815,999
For:	LIQUID CRYSTAL ALIGNMENT
Filed:	March 23, 2001
Examiner:	Hoan C. Nguyen
Art Unit:	2871

Customer No.: 27623
Attorney Docket No.: 30001064-2

APPEAL BRIEF TRANSMITTAL LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 2213-1450

Dear Sir:

Attached hereto is Appellants' Appeal Brief, in triplicate for filing said Brief in furtherance of the Notice of Appeal filed in this Application.

Respectfully submitted,

5/3/04
Date

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Attorney Docket No.: 30001064-2

APPELLANTS' APPEAL BRIEF

Dear Sir:

This is an appeal from the final rejection of claims 1 to 12, 16, 18 to 21, and 23 to 35 in a Final Office Action dated December 3, 2003.

Jurisdiction of this appeal results in the Board of Patent Appeals and Interferences under the provisions of Section 134, Title 35, United States Code, by way of a Notice of Appeal and requisite fee mailed to the USPTO with Certificate of Mailing on March 3, 2004.

TABLE OF CONTENTS

(1) REAL PARTY IN INTEREST

Hewlett-Packard Company.

(2) RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

(3) STATUS OF CLAIMS

The status of the claims in the application are as follows:

(a) Claims cancelled:	13, 14, 15, 17, and 22
(b) Claims pending:	1 to 12, 16, 18 to 21, and 23 to 35;
(c) Claims withdrawn from consideration by Examiner:	4, 5, 8 to 12, 16, 18, 20, 21, and 23 to 29;
(d) Claims allowable:	32 and 35;
(e) Claims rejected:	1 to 3, 6, 7, 19, 30, 31, 33, and 34; and
(f) Claims on appeal:	1 to 3, 6, 7, 19, 30, 31, 33, and 34.

(4) STATUS OF AMENDMENTS FILED SUBSEQUENT TO FINAL REJECTION

No amendments were filed subsequent to the Final Rejection.

(5) SUMMARY OF THE INVENTION

The present invention relates to a liquid crystal device having a surface alignment structure comprising one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce a desired alignment.

An exemplary embodiment of a liquid crystal device is shown in Figure 2. The liquid crystal device has a first cell wall 2 and a second cell wall 4 enclosing a layer of liquid crystal material; electrodes 12 and 14 for applying an electric field across at least some of the liquid crystal material; and a surface alignment structure 10 integrated onto an inner surface of the first cell wall. As explained at page 14, line 30 to page 16, line 22, the surface alignment structure provides a desired alignment to molecules of the liquid crystal material, wherein the surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped (see for example Figures 6 and 7) and orientated (see for example Figures 8 to 12) to produce the desired alignment.

(6) ISSUES

The issues presented by this appeal are the propriety of the final rejection of claims 1, 2, 6, 7, 19, 30, 31, 33, and 34 under 35 U.S.C. §102(b) as being anticipated by Japanese Patent No. 2211422 to Masahiro (hereinafter "the Masahiro patent") and the propriety of the final rejection of claim 3 under 35 U.S.C. §103(a) as being unpatentable over the Masahiro patent as applied to claims 1, 2, 6, 7, 19, 30, 31, 33, and 34 above in view of U.S. Patent No. 4,923,286 to Grupp (hereinafter "the Grupp patent").

(7) GROUPING OF THE CLAIMS

Claims 1 to 3, 6, 7, 19, 30, 31, 33, and 34 stand or fall together.

(8) ARGUMENT

Claims 1 to 12, 16, 18 to 21, and 23 to 35 are pending in the present application.

On September 15, 2003, Applicants elected claims 1 to 12, 16, 18 to 21, and 23 to 35 in response to a restriction requirement dated July 14, 2003. Applicants also elected to prosecute claims 2 to 4, 6, 7, 16, 19 and 30 to 35 on the merits to which the

claims would be restricted if no generic claim is finally held to be allowable. The restriction requirement stated that claim 1 is currently generic.

<u>Lack of Propriety of Rejection under 35 U.S.C. §102(b)</u>

Claims 1, 2, 6, 7, 19, 30, 31, 33 and 34 are rejected under 35 U.S.C. §102(b) as being anticipated by the Masahiro patent.

An anticipation rejection under 35 U.S.C. §102(b) "requires the disclosure in a single prior art reference of each element of the claim under consideration." *W.L. Gore & Assoc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing *Soundscriber Corp. v. United States*, 360 F.2d 954, 960, 148 USPQ 298, 301 (Ct. Cl.), *adopted*, 149 USPQ 640 (Ct. Cl. 1966)), *cert. denied*, 469 U.S. 851 (1984).

The Masahiro patent fails to disclose each and every element of claims 1, 2, 6, 7, 19, 30, 31, 33 and 34.

The Masahiro patent is directed to a substrate having a surface, which is formed into a ruggedness by etching using hydrofluoric acid. An ITO film is formed on the surface and the film is subjected to an orientation treatment. It is this orientation treatment, and not the ruggedness, that provides alignment to liquid crystal material.

The Final Office Action dated December 12, 2003 states on pages 3 and 4 that the Masahiro patent "teaches (Figs. 1-3) a liquid crystal device comprising:

- a first cell wall and a second cell wall enclosing a layer of liquid crystal material;
- electrodes for applying an electric field across at least some of said liquid crystal material; and
- a surface alignment structure integrated onto an inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

- an analyzer and polariser (upper and lower polarization plates 8/14) according to claim 33

Wherein

- said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and oriented to produce said desired alignment.
- the geometry and spacing of the features is such as to cause the liquid crystal material to adopt a locally planar or tilted planar alignment (claim 2).
- the features are shaped and/or oriented so as to produce a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction (claims 6 and 30).
- the features are shaped and/or oriented so as to produce a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions (claims 7 and 31).
- the features are at least one of a different height, different shape, different tilt and different orientation in different regions of the device (claim 34)."

Applicants had submitted a response to a previous Office Action dated December 26, 2002, in which claims 1 to 8, 10 to 12, 15, 16, 18, and 19 were rejected under 35 U.S.C. § 102(b) as being anticipated by the Masahiro patent. The Office Action dated December 26, 2002 stated, in part, on page 7, that the Masahiro patent "teaches a liquid crystal device comprising:

- a first cell wall and a second cell wall enclosing a layer of liquid crystal material;
- electrodes for applying an electric field across said liquid crystal material; and
- a surface alignment structure integrated onto an inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein

- said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment...
- the geometry and spacing of the features is such as to cause the liquid crystal material to adopt a locally planar or tilted planar alignment...
- the features are shaped and/or orientated so as to produce a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction...
- the features are shaped and/or orientated so as to produce a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions."

The Applicants argued, in part, that the Masahiro patent did not disclose or suggest upstanding features that are at least one of shaped and oriented to produce a desired alignment, as required by independent claims 1 and 19. In support of this argument, Applicants submitted a Declaration under 37 C.F.R § 1.132 by Stephen Christopher Kitson, one skilled in the art of liquid crystal displays, particularly in the alignment of nematic liquid crystal materials on microstructured surfaces [a copy of the Declaration is attached in Appendix A]. The following is an excerpt from that Declaration:

> 14. The abstract of Masahiro states the purpose of the invention is "[t]o obtain a uniform contrast in a wide visual angle range by forming the surface of an electrode substrate on the side in contact with a liquid crystal layer to a rugged shape." In my opinion, Masahiro provides a liquid crystal display having uniform contrast over a wide angle of view. This is said to be achieved by providing a rugged substrate on which is formed an ITO (transparent conductor) film. My interpretation of the term "rugged" is that the surface is roughened. The roughness is achieved by an etching treatment such as hydrofluoric acid. It appears that the cell gap is modulated at random across the display. The optical response of an LC layer is determined by the product of its refractive index anisotropy (delta n) and the thickness of the layer (d). As the viewing angle changes, the layer thickness through which a user looks through effectively

increases. Consequently, the brightness of such displays decreases at higher angles.

15. In Masahiro the microstructure is used to randomise the thickness of the layer and not to produce a desired alignment of the liquid crystal material, as recited in the claims of the present invention. The microstructure is actually quite large, having spacings of 10 to 500 μm and height up to 5 μm (see Operational Examples of Masahiro). The thickness of an LC layer in a typical device is of the order of 5 μm, so this variation in layer thickness is substantial. The result would be that at any angle the user would see a mixture of layer thicknesses on a fine pitch which will tend to even out the optical response giving a more uniform viewing angle, at the expense of reducing the overall brightness. I would expect some problems in achieving uniform switching because the LC will experience different electric field strengths in different regions of the display depending on the layer thickness (and therefore distance between electrodes) in the different regions.

16. Masahiro does not describe or suggest that the roughened surface provides an orientation effect on the liquid crystal material. In the present invention the surface alignment structure provides a desired alignment to the molecules of the liquid crystal material. The surface alignment structure comprises upstanding features that are at least one of shaped and oriented to produce the desired alignment. By controlling the shape of the upstanding features of the present invention, particular desired alignments can be achieved. The abstract of Masahiro states that the roughened surface is "[t]o obtain a uniform contrast in a wide visual angle range," as discussed above. In fact, in order to achieve alignment of the liquid crystal material, Masahiro subjects the ITO film to an orientation treatment. The abstract says that "The film is subjected to an orientation treatment". This appears to be a reference to treatment of the ITO film with a conventional alignment agent, for example a rubbed polymer. My opinion is that it is this "orientation treatment", not the surface roughness underlying the ITO film, which produces an orientation of the LC molecules in Masahiro. This conclusion is supported by the examples in Masahiro which are of a twisted nematic (TN) display. As discussed in the introduction to the present application, at page 2, lines 7-10, a TN display requires the inner surface of each cell wall to be treated to produce a planar unidirectional alignment of the nematic director, with the alignment directions being at 90° to each other. In my opinion, such a planar unidirectional alignment would not be obtained by any

> effect of the roughened substrate produced by etching with hydrofluoric acid. Rather, such alignment would result from the "orientation treatment" to which the ITO is said to be subjected and which (absent any contrary indication) must be understood to be a conventional alignment treatment.
>
> 17. Thus I believe that Masahiro neither discloses nor suggests upstanding features that are at least one of shaped and oriented to produce a desired alignment, as recited in the claims of the present invention.

Applicants respectfully submit that the Masahiro patent fails to disclose or suggest a surface alignment structure integrated onto an inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material, wherein the surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, as in claim 1. More particularly, the Masahiro patent fails to disclose or suggest upstanding features that are at least one of shaped and oriented to produce a desired alignment. As the Declaration of Stephen Christopher Kitson reports, "the roughness in Masahiro is used to randomize the thickness of the layer and not to produce a desired alignment of the liquid crystal material. ... Masahiro does not describe or suggest that the roughened surface provides an orientation effect on the liquid crystal material." In fact, as the Declaration points out, it is the orientation treatment over the ITO film that provides the alignment of the liquid crystal material. There is no indication in the Masahiro patent that the roughness does or is capable of producing a desired alignment of the liquid crystal material as in claims 1 and 19. Therefore, Applicants respectfully submit that claims 1 and 19 are patentably distinguishable over the cited art.

"Evidence traversing rejections must be considered by the examiner whenever present...Where the evidence is insufficient to overcome the rejection, the examiner must specifically explain why the evidence is insufficient." MPEP §716.01.

The Final Office Action of December 3, 2003 states that Applicants' arguments have been considered but are moot in view of the new grounds of rejection (page 2 of the Final Office Action). However, the Final Office Action rejects the claims on the same basis using the Masahiro patent as were presented in the previous Office Action. On page 5, the Final Office Action then attempts to dismiss the Applicants' arguments as not persuasive without specifically addressing the Declaration, which was presented as evidence to the failure of the Masahiro patent to disclose each and every element of the claimed invention.

The Final Office Action of December 3, 2003 attempts to rebut Applicants' arguments by pointing to Figures 1 to 3; page 3, lines 12 to 18; and page 4, lines 11 to 16 of the English translation of the Masahiro patent, a copy of which is attached in Appendix B. However, Applicants respectfully submit that Figures 1 to 3 fail to disclose or suggest upstanding features that are at least one of shaped and oriented to produce a desired alignment. In fact, the textual portions of the Masahiro patent indicated by the Final Office Action support the arguments made by the Applicants and the Declaration of Stephen Christopher Kitson. Page 3, lines 12 to 18 of the Masahiro patent states:

> Figure 1 is a cross-sectional diagram showing the liquid crystal shutter based on this invention. In the figure, item 1 designates an upper polarization plate. Item 2 designates an upper electrode plate having a flat electrode surface subjected to an orientation process. Item 3 is a nematic liquid crystal layer which is twisted at 90°, which is narrowly supported by the lower electrode substrate 6 facing against the electrode substrate 2 and sealing material 4.

Nowhere in this passage is disclosed or suggested upstanding features that are at least one of shaped and oriented to produce a desired alignment. Further, page 3, lines 18 to 20 of the Masahiro patent states:

> The surface contacting the liquid crystal layer 3 of the lower electrode substrate 6 is prepared by etching the glass surface using fluoric acid, ***over which an ITO is formed and subjected to an orientation treatment*** [emphasis added].

As discussed above and in the Declaration, it is this conventional orientation treatment, and not the ruggedness of the surface, that is responsible for any alignment of liquid crystal material. In fact, the Masahiro reference fails to disclose anything related to alignment of liquid crystal material except for the use of this conventional orientation treatment.

Page 4, lines 11 to 16 of the Masahiro patent is related solely to the vision angle dependency of the liquid crystal cell as a function of the multiplied value of refraction ratio aerotropic characteristic (_n) and cell thickness of the liquid crystal (d). This passage fails to disclose or suggest upstanding features that are at least one of shaped and oriented to produce a desired alignment. As discussed in the Declaration, this passage deals with viewing angle changes and optical response, however, it does not disclose or suggest alignment of the liquid crystal material.

Accordingly, Applicants respectfully submit that the Masahiro patent fails to disclose each and every element of independent claims 1 and 19, which are, thus, patentably distinguishable over the Masahiro patent. Further, Applicants respectfully submit that claims 2, 6, 7, 30, 31, 33 and 34, which depend from claim 1, are also patentably distinguishable over the Masahiro patent for at least the reasons discussed above with respect to claim 1.

Dependent claim 2 adds the element that the geometry and spacing of the features is such as to cause the liquid crystal material to adopt at least one of a locally planar or tilted planar alignment.

Applicants respectfully submit that the Masahiro patent fails to disclose or suggest features having geometry and spacing such as to cause the liquid crystal material to adopt at least one of a locally planar or tilted planar alignment. As discussed above with respect to claim 1, the Masahiro patent does not disclose or suggest upstanding features that produce a desired alignment. Therefore, the Masahiro patent does not have such features with geometry and spacing such as to cause the liquid

crystal material to adopt at least one of a locally planar or tilted planar alignment. The Final Office Action failed to address this argument, which was previously made in Applicants' response to the Office Action dated December 26, 2002, and has pointed to no evidence in the Masahiro patent to the contrary. Accordingly, claim 2 is further patentably distinguishable over the cited art.

Claim 6 depends from claim 1 and claim 30 depends from claim 2. Each adds the element that the features are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction.

The Final Office Action at page 6 states that Figure 2 of the Masahiro patent teaches "the features are shaped and/or oriented so as to produce a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction." However, as discussed above with respect to claim 1, Applicants can find no disclosure or suggestion in Figure 2 to upstanding features that produce any desired alignment, let alone features that are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction, as in claim 6. Applicants respectfully submit that the Masahiro patent does not disclose or suggest features that are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction, as in claims 6 and 30. Therefore, claims 6 and 30 are further patentably distinguishable over the Masahiro patent.

Claim 7 depends from claim 1 and claim 31 depends from claim 2. Each adds the element that the features are at least one of shaped and oriented to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions.

The Final Office Action at page 6 states that Figure 3 of the Masahiro patent teaches "the features are shaped and/or oriented so as to produce a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of directions." However, as discussed above with respect to claim 1, Applicants can find no disclosure or suggestion in Figure 2 to upstanding features that produce any desired alignment, let alone features that are at least one of shaped and oriented to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions. Applicants respectfully submit that the Masahiro patent does not disclose or suggest features that are at least one of shaped and oriented to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions, as in claims 7 and 31. Therefore, claims 7 and 31 are further patentably distinguishable over the cited art.

Lack of Propriety of Rejection Under 35 U.S.C. §103(a)

Claim 3 is rejected under 35 U.S.C. §103(a) as being unpatentable over the Masahiro patent as applied to claims 1, 2, 6, 7, 30, 31, 33, and 34 above in view of the Grupp patent.

Pages 4 and 5 of the Final Office Action states that the Grupp patent

> teaches (in abstract) a family of cells having a hybrid alignment is known as HAN (Hybrid Aligned Nematic), in which the inner surface of the second cell wall is treated to produce a locally homeotropic alignment of the liquid crystal material, whereby the cell functions in a hybrid aligned nematic mode, for varying transmission and colour in dependence on the electric field providing a very flat electro-optical transmission curve.
>
> Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify a liquid crystal device as Masahiro disclosed with the inner surface of the second cell wall treated to produce a locally homeotropic alignment of the liquid crystal material, whereby the cell functions in a hybrid aligned nematic mode, for varying transmission and colour in dependence on the electric field providing a very flat electro-optical transmission curve.

Claim 3 depends indirectly from claim 1 and adds the elements that the geometry and spacing of the features is such as to cause the liquid crystal material to adopt at least one of a locally planar or tilted planar alignment and that the inner surface of the second cell wall is treated to produce a locally homeotropic alignment of the liquid crystal material, whereby the cell functions in a hybrid aligned nematic mode.

For an obviousness rejection to be proper, the Examiner must meet the burden of establishing that ***all elements of the invention are disclosed in the prior art***; that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, must contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references; and that the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *In re Fine*, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988); *In Re Wilson*, 165 U.S.P.Q. 494, 496 (C.C.P.A. 1970); *Amgen v. Chugai Pharmaceuticals Co.*, 927 U.S.P.Q.2d, 1016, 1023 (Fed. Cir. 1996).

The Final Office Action has failed to establish a *prima facie* case of obviousness. To establish *prima facie* obviousness of a claimed invention, the prior art references must teach or suggest all of the claim limitations. *See In re Fine*. As discussed above with respect to claims 1 and 19, the Masahiro patent fails to disclose or suggest upstanding features that are at least one of shaped and oriented to produce a desired alignment, as required by claim 3. Further, as discussed above with respect to claim 2, the Masahiro patent fails to disclose or suggest the geometry and spacing of the features is such as to cause the liquid crystal material to adopt at least one of a locally planar or tilted planar alignment, as required by claim 3.

The Grupp patent fails to cure the deficiencies of the Masahiro patent. In particular, the Grupp patent fails to disclose or suggest upstanding features that are at least one of shaped and oriented to produce a desired alignment, as required by claim

3. Further, the Grupp patent fails to disclose or suggest the geometry and spacing of the features is such as to cause the liquid crystal material to adopt at least one of a locally planar or tilted planar alignment, as required by claim 3. Accordingly, claim 3 is patentably distinguishable over the cited art, alone or in combination.

PRAYER FOR RELIEF

Reversal of the final rejections of claims 1 to 3, 6, 7, 19, 30, 31, 33, and 34 and an indication of the patentability of claims 1 to 12, 16, 18 to 21, and 23 to 35 over the reference disclosures is respectfully requested.

Respectfully submitted,

5/3/04
Date

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Kitson et al.

Serial No: 09/815,999

For: LIQUID CRYSTAL ALIGNMENT

Filed: March 23, 2001

Examiner: Hoan C. Nguyen

Art Unit: 2871 Attorney Docket No.: 30001064-2

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Declaration Under 37 C.F.R § 1.132

I, Stephen Christopher Kitson, a citizen of the United Kingdom and a resident of 10 Stoney Stile Road, Alveston, Bristol, declare as follows.

1. I was awarded a first class honours degree in physics from the University of Exeter, UK, in 1991 and a PhD in physics also from the University of Exeter in 1995.

2. I am currently a research scientist with Hewlett-Packard Limited, a position I have held since 17th August 1998. Since that time I have worked extensively in the area of liquid crystal display research and development, focusing in particular on the alignment of nematic liquid crystal materials on microstructured surfaces. In my previous positions (research scientist at the Defence Evaluation and Research Agency, UK, 1996 – 1998, and as a post-doctoral research assistant at Exeter University, 1994 – 1996) I worked on different aspects of microstructured surfaces, in particular the novel optical properties of sub-wavelength structures.

3. I have read the specification and claims of US Patent Application No. 09/815,999 (the present application) for which I am named as an inventor, and the citations and objections raised by the Examiner at the USPTO and am familiar with their contents.

4. The present invention relates to a liquid crystal device having an alignment structure on an inner surface of a cell wall comprising a random or pseudorandom two-dimensional array of upstanding features, for example, posts. The liquid crystal alignment which can be achieved depends on the shape and orientation of the features, rather than the lattice arrangement. Alignment that is planar, tilted planar, or homeotropic may be obtained by suitable selection of the correct shape and orientation of the upstanding features, and a bistable alignment can also be achieved. Effectively randomizing the features in two dimensions over the entire area of the display enables optimization of the alignment without the undesirable optical diffraction effects that result from a regular lattice or grating. The desired alignment is produced without rubbing or evaporation of inorganic oxides, and hence without the problems associated with such production methods, as described in the introduction to the present application.

5. In my opinion, none of the prior art of record discloses or suggests the present invention as defined in the claims presently on file. My comments on each of the prior art documents cited in the latest Office Action (dated 26 December 2002) are given below.

Yasushi (JP5088177)

6. Yasushi describes how a conventional LC alignment film is formed by applying a polymer film to a substrate with electrodes thereon and rubbing the film with a fabric to produce a grooved polymer film. As is well known, LC molecules tend to align themselves in the groove direction, i.e. to "lie down" along the grooves in a planar or tilted planar alignment. This method has drawbacks including build-up of static electricity caused by the rubbing, damage to the surface and the accumulation on the surface of fibrous debris from the rubbing process. For large area displays, producing uniform alignment by this method is difficult. These drawbacks can cause display defects.

7. Yasushi discloses an alternative orientation treatment which is intended to replace the described prior art treatment. This involves providing on the substrate a polymeric orientation film that has periodic or non-periodic asymmetrical concave and convex shaped patterns. This is done by coating the substrate with a photoresist or photosensitive polyimide film, exposing the film through a mask having slits of a periodic pattern to produce a series of parallel rectangular walls, and then using ion beam etching to form the rectangular walls into asymmetric triangular-shaped walls, as shown in Figures 1 and 2.

8. As with the prior art, the film comprises a series of grooves that align the LC in a planar or tilted planar orientation. Yasushi found that symmetrical grooves (or walls) do not produce as good an alignment as asymmetrical grooves, which give results comparable to conventional rubbed polymer films, as shown in Figure 4 of Yasushi.

9. Yasushi discloses an alignment film which comprises a periodic or non-periodic series of parallel polymer walls of asymmetric shape that define between them corresponding parallel grooves of asymmetric shape. The parallel walls are arranged in a one-dimensional array, i.e., as a single row of unsymmetrical walls that span the display.

10. It should be noted that the symmetry or non-symmetry of each wall makes no difference to the fact that the walls are arranged in a one-dimensional array, i.e., the arrangement can be defined with reference to the position of each wall along a single axis on the surface of the substrate.

11. Unlike the present invention, Yasushi does not describe or suggest a two-dimensional array of upstanding features, but rather a conventional one-dimensional array in common with other prior art alignment means. Yasushi does not disclose means for achieving homeotropic alignment, bistable alignment, or different alignments in different regions of the display, all of which may be achieved using two-dimensional arrays of upstanding features, notably posts, as recited in the claims of the present application. Moreover, since the purpose of Yasushi is to provide a replacement for the conventional rubbed polymer grooved surface (by providing a grooved surface without rubbing), Yasushi provides no teaching or incentive to arrive at the claims of the present invention.

12. It should be noted that, in clear distinction from Yasushi, the independent claims of the present invention recite an array of features which can be defined with reference to the position of each feature on two axes. Yasushi is a one-dimensional array. The array of features of Yasushi is not a two dimensional array of upstanding features, as recited in the claims of the present invention.

Hiroshi (JP10148827)

13. Hiroshi relates to the use of random roughness to control the reflectivity of a reflecting layer by making it scatter light. The abstract states that a film is to be applied "to obtain uniform thickness of the liquid crystal layer 4". In my opinion, Hiroshi provides for an inorganic film such as silicon oxide or an organic film to be formed on the roughened surface of the metal reflector. Thus, the film "fills in the dips," and the roughness of the metal reflector is not "experienced" by the liquid crystal molecules. The liquid crystal molecules do not come into contact with the roughness or the metal film. The roughness therefore has no effect on the LC alignment. Instead the alignment is determined by the film that is formed on top of the roughened layer, which is a conventional alignment technology. Hiroshi does not describe or suggest a surface alignment structure integrated onto an inner surface of a first cell wall providing a desired alignment to molecules of the liquid crystal material, wherein the surface alignment structure comprises one of a random or pseudorandom two dimensional array of

upstanding features that are at least one of shaped and oriented to produce the desired alignment, as recited in the independent claims of the present invention. For this reason, Hiroshi is not relevant to the present invention except as general background art.

Masahiro (JP2211422)

14. The abstract of Masahiro states the purpose of the invention is "[t]o obtain a uniform contrast in a wide visual angle range by forming the surface of an electrode substrate on the side in contact with a liquid crystal layer to a rugged shape." In my opinion, Masahiro provides a liquid crystal display having uniform contrast over a wide angle of view. This is said to be achieved by providing a rugged substrate on which is formed an ITO (transparent conductor) film. My interpretation of the term "rugged" is that the surface is roughened. The roughness is achieved by an etching treatment such as hydrofluoric acid. It appears that the cell gap is modulated at random across the display. The optical response of an LC layer is determined by the product of its refractive index anisotropy (delta n) and the thickness of the layer (d). As the viewing angle changes, the layer thickness through which a user looks effectively increases. Consequently, the brightness of such displays changes at higher angles.

15. In Masahiro the microstructure is used to randomise the thickness of the layer and not to produce a desired alignment of the liquid crystal material, as recited in the claims of the present invention. The microstructure is actually quite large, having spacings of 10 to 500 μm and height up to 5 μm (see Operational Examples of Masahiro). The thickness of an LC layer in a typical device is of the order of 5 μm, so this variation in layer thickness is substantial. The result would be that at any angle the user would see a mixture of layer thicknesses on a fine pitch which will tend to even out the optical response giving a more uniform viewing angle, at the expense of reducing the overall brightness. I would expect some problems in achieving uniform switching because the LC will experience different electric field strengths in different regions of the display depending on the layer thickness (and therefore distance between electrodes) in the different regions.

16. Masahiro does not describe or suggest that the roughened surface provides an orientation effect on the liquid crystal material. In the present invention the surface alignment structure provides a desired alignment to the molecules of the liquid crystal material. The surface alignment structure comprises upstanding features that are at least one of shaped and oriented to produce the desired alignment. By controlling the shape of the upstanding features of the present invention, particular desired alignments can be achieved. The abstract of Masahiro states that the roughened surface is "[t]o obtain a uniform contrast in a wide visual angle range," as discussed above. In fact, in order to achieve alignment of the liquid crystal material, Masahiro subjects the ITO film to an orientation treatment. The abstract says that "The film is subjected

to an orientation treatment". This appears to be a reference to treatment of the ITO film with a conventional alignment agent, for example a rubbed polymer. My opinion is that it is this "orientation treatment", not the surface roughness underlying the ITO film, which produces an orientation of the LC molecules in Masahiro. This conclusion is supported by the examples in Masahiro which are of a twisted nematic (TN) display. As discussed in the introduction to the present application, at page 2, lines 7-10, a TN display requires the inner surface of each cell wall to be treated to produce a planar unidirectional alignment of the nematic director, with the alignment directions being at 90° to each other. In my opinion, such a planar unidirectional alignment would not be obtained by any effect of the roughened substrate produced by etching with hydrofluoric acid. Rather, such alignment would result from the "orientation treatment" to which the ITO is said to be subjected and which (absent any contrary indication) must be understood to be a conventional alignment treatment.

17. Thus I believe that Masahiro neither discloses nor suggests upstanding features that are at least one of shaped and oriented to produce a desired alignment, as recited in the claims of the present invention.

18. I can find no disclosure or teaching in any of the citations raised against the present application by the Examiner which shows that LC alignment should be achieved by means of a random or pseudorandom two-dimensional array of upstanding features on an inner surface of a cell wall, as recited in the claims of the present invention.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed: S. Kitson

STEPHEN CHRISTOPHER KITSON

Dated: 27th May 2003

PTO 03-0803

CY=JP DATE=19900822 KIND=A
PN=02-211422

LIQUID CRYSTAL SHUTTER
[Ekisho shatta]

Masahiro Kuroiwa

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. December 2002

Translated by: FLS, Inc.

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INVENTOR	(72):	KUROIWA, MASAHIRO
APPLICANT	(71):	Seiko Epson K.K.
TITLE	(54):	LIQUID CRYSTAL SHUTTER
FOREIGN TITLE	[54A]:	Ekisho shatta

Specification

1. Name of this invention

Liquid Crystal Shutter

2. Claims

Liquid crystal shutter with the following characteristic:

With a liquid crystal shutter having a liquid crystal cell narrowly holding a liquid crystal layer oriented between a pair of electrode substrates having an electrode on each of the inner surface and a polarizing plate formed on the outside surface of at least one of said liquid crystal cell,

at least one of the surface contacting said liquid crystal layer of the electrode substrate is made into a surface with ruggedness.

3. Detailed Explanation of this Invention

[Industrial Field]

This invention pertains to a liquid crystal shutter.

[Conventional Technology]

With the conventional liquid crystal shutter, both side surfaces contacting the liquid crystal layer of a pair of electrode substrates tightly holding a liquid crystal layer are made as smooth surfaces.

[Problems to Be Solved by this Invention]

When the electrode surfaces of the electrode substrates are smooth as in the case of conventional device, a liquid crystal shutter requiring a uniform contrast has a limited

vision angle, particularly at the time of voltage impression.

This invention was developed to solve this problem. The purpose of this invention is to provide a liquid crystal shutter having a wide vision angle range with a uniform contrast.

[Method to Solve the Problems]

To achieve the purpose as described above, this invention provides a liquid crystal shutter with the following characteristic:

With a liquid crystal shutter having a liquid crystal cell narrowly holding a liquid crystal layer oriented between a pair of electrode substrates having an electrode on each of the inner surface and a polarizing plate formed on the outside surface of at least one of said liquid crystal cell, at least one of the surface contacting said liquid crystal layer of the electrode substrate is made into an uneven surface.

[Operational Examples]

Figure 1 is a cross-sectional diagram showing the liquid crystal shutter based on this invention. In the figure, item **1** designates an upper polarization plate. Item **2** designates an upper electrode plate having a flat electrode surface subjected to an orientation process. Item **3** is a nematic liquid crystal layer which is twisted at 90°, which is narrowly supported by the lower electrode substrate **6** facing against the electrode substrate **2** and sealing material **4**. The surface contacting the liquid crystal layer **3** of the lower electrode substrate **6** is prepared by etching the glass surface using fluoric acid, over which an ITO is formed and subjected to an orientation treatment. Item **5** is a spacer for maintaining a specific space between the upper and lower electrode substrates **2**, **6**, being mixed in the seal material **4**. Item **7** is a lower polarization plate. With the liquid shutter structured in this manner, the following explains the detailed configuration while referring to Fig. 2. In

Fig. 2, the lower electrode substrate **6** is etched using fluoric acid, etc. to form ruggedness, onto which an ITO is formed using a spattering method, etc. The degree of ruggedness after the formation of ITO is 0 - 5 μm in its height (h), and the space (l) between the bottoms and tops of the ruggedness is 10 μm - 500 μm, being irregularly arranged.

The lower electrode substrate having the surface as described above and upper electrode surface **2** having a smooth electrode surface are made into a liquid crystal cell as shown in Fig. 1. In this case, if the spacer **5** is 5 μ, the cell thickness (d) of the liquid crystal cell consists of fully irregularly formed between 5 μ - 10 μ.

ON the other hand, the vision angle dependency of the liquid crystal cell occurs according to the multiplied value of refraction ratio aerotropic characteristic _n and cell thickness of the liquid crystal (i.e., forming a degree of _n x d; color changes) due to the newly formed vision angle. Assuming that the _n of the crystal layer **3** in Fig. 2 is set as 0.08, _d x d irregularly exists within a range of 0.4 - 0.8 μm in the same sell; when _n is set as 0.16, _n x d irregularly exists within a range of 0.8 - 1.6.

Therefore, the value of _n·d changes at a fine pitch (l= 10 - 500 μm), the color produced by each _n·d is reduced, thereby making the panel color almost invisible. Also, when the liquid crystal cell is observed from a oblique direction, since _n·d changes at a dense pitch in the same manner, the chromaticity is not formed, subsequently allowing the production of liquid crystal shutter having a uniform contrast in a wide range of vision angles.

Figure 4 is a chart showing the relation between the vision angle direction and permeation ratio (at 0N time) of a liquid crystal shutter structured as described in

Operational example 1 and the conventional TN type liquid crystal shutter.

The conditions of the cells are described below. As shown in Fig. 4, the liquid crystal display device based on this invention can provide wider vision field range and more uniform contrast compared with the results obtained from the conventional TN type liquid crystal shutter.

Liquid crystal shutter based on this invention (A):

- Positive type (the permeation ratio at the time of non-voltage impression is displayed higher than the permeation ratio at the time of impression time)
- _n·d range = 0.8 - 1.6 μ
- Twist angle = 90°

TN type liquid crystal shutter (B):

- Positive type
- _n·d range = 1.1 μ
- Twist angle = 90°

Measurement condition:

The entire circumference of the permeation ratio changes was measured from the direction where the angle θ in the diagonal direction of the cell was 30°.

Drive condition:

5V-STATIC wave was impressed.

Operational example 2:

Figure 3 is a cross-sectional diagram of the liquid crystal shutter for Operational example 2. In the figure, items **8** designates an upper polarization plate. Items **9** and **13**

respectively designate the upper and lower electrode substrates. The surface contacting the liquid crystal layer **10** is prepared by etching the glass surface using fluoric acid, etc., on which an ITO is formed and subjected to orientation. Item **10** is a liquid crystal layer is a nematic liquid crystal layer twisted for 90°, being narrowly supported by the seal material 11 and spacer **12**. Item **14** is a lower polarization plate.

The degree of ruggedness after forming an ITO for the upper and lower electrode substrates **9** and **13** are both 0 - 5 μm, and the space between the top and bottom of ruggedness is irregularly arranged within a range of 10 μm - 500 μm.

When a 3 μm spacer is used with the cell structure as described above, irregular cell thickness (3 - 13 μ) is formed in the same cell. When _n is 0.14, _n x d irregularly exists within a range of 0.42 - 1.82 in the same cell. Therefore, as described in Operational example 1, a liquid crystal shutter having a wide range of vision angle with a uniform contrast can be proved.

Operational example 3:

Figure 5 is a diagram showing an example when the liquid crystal shutter prepared in Operational example 1 is used as a sun glass. The liquid crystal shutter **17** based on this invention used as a glass lens is made into positive type and designed to be set ON-OFF by the photoelectric motive force by a solar battery **16**. Item **15** is a glass frame containing an internally built circuit on the back side of the solar battery for liquid crystal operation.

Note that, although the examples used a nematic liquid crystal twisted for 90°, this invention is not limited to those examples, as any twisting angle and liquid crystal material

can be used as long as applicable to the photoelectric motive elements. Also, the ruggedness of the electrode substrate is not particularly limited in this invention.

[Effectiveness of this Invention]

As described above, with the configuration of this invention, a liquid crystal shutter having a uniform contrast within a wide range of vision angle can be provided. Particularly, the method based on this invention is effective for glass shutters used as a liquid crystal sunglass and 3D device (3-D image device).

4. Simple Explanation of the Figures

Figure 1 is a cross-sectional diagram showing the liquid crystal shutter based on this invention. Figure 2 is a diagram showing more detailed structure of the device shown in Fig. 1. Figure 3 is a cross-sectional diagram of a liquid crystal shutter used in Operational example 2 of this invention. Figure 4 is a chart showing the relation between the vision angle direction and permeation ratio (permeation ratio changes in the circumference direction when the angle in the diagonal direction is 30°). Figure 5 is a diagram showing an example when the liquid crystal shutter prepared in Operational example 1 is used as a sun glass.

1...Polarization plate 1;

2...Upper electrode substrate;

3...Liquid crystal layer;

4...Seal material;

5...Spacer;

6...Lower electrode substrate;

7...Lower polarization plate;

h...Gap between the top and bottom of ruggedness on the ITO of a lower electrode substrate;

l...Space between the top and bottom of ruggedness on the ITO of a lower electrode substrate;

d...Cell thickness;

8...Upper polarization plate;

9...Upper electrode substrate;

10...Liquid crystal layer;

11...Seal material;

12...Spacer;

13...Lower electrode substrate;

14...Lower polarization plate;

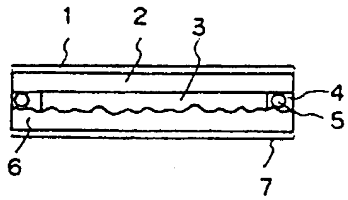
A...Vision angle-permeation ratio characteristic of the liquid crystal shutter of this invention;

B...Vision angle-permeation ratio characteristic of TN type liquid crystal shutter;

15...Glass frame;

16...Solar battery;

17...Liquid crystal shutter of this invention



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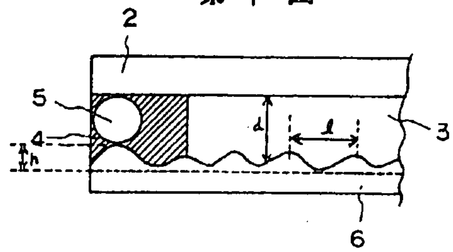

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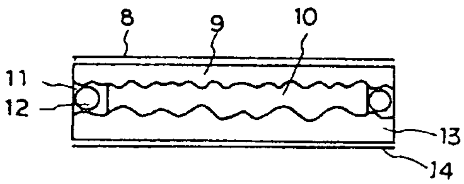

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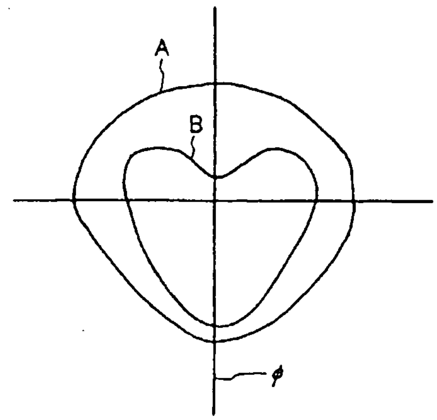

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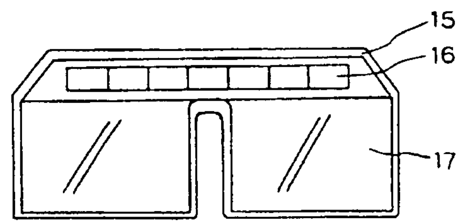

第 5 図

APPENDIX C

(9) APPEALED CLAIMS

A copy of the claims on appeal is set forth in this Appendix.

1. A liquid crystal device comprising:
a first cell wall and a second cell wall enclosing a layer of liquid crystal material;
electrodes for applying an electric field across at least some of said liquid crystal material; and
a surface alignment structure integrated onto an inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,
wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment.

2. A device as claimed in claim 1, wherein the geometry and spacing of the features is such as to cause the liquid crystal material to adopt at least one of a locally planar or tilted planar alignment.

3. A device as claimed in claim 2, wherein the inner surface of the second cell wall is treated to produce a locally homeotropic alignment of the liquid crystal material, whereby the cell functions in a hybrid aligned nematic mode.

4. A device as claimed in claim 2, wherein the inner surface of the second cell wall is treated to produce at least one of a locally planar or tilted planar alignment of the liquid crystal material substantially at right angles to the alignment direction on the first cell wall, whereby the cell functions in a TN mode.

5. A device as claimed in claim 1, wherein the geometry and spacing of the features is such as to cause the liquid crystal material to adopt a locally homeotropic alignment.

6. A device as claimed in claim 1, wherein the features are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction.

7. A device as claimed in claim 1, wherein the features are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions.

8. A device as claimed in claim 1, wherein the features comprise posts which are tilted with respect to the normal to the plane of the first cell wall.

9. A device as claimed in claim 1, further including an analyser and a polariser mounted on the cell walls.

10. A device as claimed in claim 1, wherein the features are at least one of different height, different shape, different tilt and different orientation in different regions of the device.

11. A device as claimed in claim 1, wherein said features comprise posts, and wherein a tilt angle and orientation of the posts are uniform throughout the device.

12. A cell wall for use in manufacturing a liquid crystal device according to claim 1, comprising a substrate and a surface alignment structure on one surface thereof for aligning the director of a liquid crystal material, said surface alignment structure comprising one of a random or pseudorandom two dimensional array of upstanding features which are at least one of shaped and orientated to produce the desired alignment.

13. (Cancelled)

14. (Cancelled)

15. (Cancelled)

16. A device as claimed in claim 2, wherein the inner surface of the second cell wall is treated to produce at least one of a locally planar or tilted planar alignment of the liquid crystal material substantially at right angles to the alignment direction on the first cell wall, whereby the cell functions in an STN mode.

17. (Cancelled)

18. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material;

a surface alignment structure integrated onto an inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, and

wherein said array of upstanding features is not treated with or formed from a material which will induce local homeotropic alignment of said liquid crystal material.

19. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material;

a surface alignment structure integrated onto an inner surface of at least said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, and

wherein said molecules, when adjacent to said cell wall surface between said features, adopt an alignment which is one of planar and tilted planar.

20. A liquid crystal device as claimed in claim 1, wherein said features comprise a plurality of separate and distinct upstanding features.

21. A liquid crystal device as claimed in claim 1, wherein said array of upstanding features is not treated with or formed from a material which will induce local homeotropic alignment of said liquid crystal material.

22. (Cancelled)

23. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material; and

a surface alignment structure on said inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, said features having different sizes in different regions of said first cell wall.

24. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material; and

a surface alignment structure on said inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, and wherein said features have different shapes in different regions of said first cell wall.

25. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material; and

a surface alignment structure on said inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, and

wherein said features have different tilt angles in different regions of said first cell wall.

26. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material; and

a surface alignment structure on said inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, and

wherein said features have different orientations in different regions of said first cell wall.

27. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material; and

a surface alignment structure on said inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, each of said features having the same shape and wherein said features are randomly orientated.

28. A liquid crystal device comprising:

a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of said liquid crystal material; and

a surface alignment structure on said inner surface of said first cell wall providing a desired alignment to molecules of said liquid crystal material,

wherein said surface alignment structure comprises one of a random or pseudorandom two dimensional array of upstanding features that are at least one of shaped and orientated to produce said desired alignment, and

wherein said features have a plurality of shapes and a plurality of sizes.

29. A liquid crystal device as claimed in claim 24, wherein said features have different orientations in different regions of said first cell wall.

30. A device as claimed in claim 2, wherein the features are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a single azimuthal direction.

31. A device as claimed in claim 2, wherein the features are at least one of shaped and orientated so as to produce one of a substantially uniform planar or tilted planar alignment of the liquid crystal director in a plurality of azimuthal directions.

32. A device as claimed in claim 2, wherein the features comprise posts which are tilted with respect to the normal to the plane of the first cell wall.

33. A device as claimed in claim 2, further including an analyser and a polariser mounted on the cell walls.

34. A device as claimed in claim 2, wherein the features are at least one of different height, different shape, different tilt and different orientation in different regions of the device.

35. A device as claimed in claim 2, wherein said features comprise posts, and wherein a tilt angle and orientation of the posts are uniform throughout the device.